

transistors are substantially the same film thickness and wherein a drain concentration of thin-film transistors (TFT) is in a range of about  $3E+19/cm^3$  to  $1E+20/cm^3$ .

[11] Thus, according to the present invention, it is possible to form a plurality of thin-film transistors (TFTs) having a lower driving voltage and thin-film transistors having a higher driving voltage on a glass substrate at a single gate insulating film by setting the range of drain concentration. The range of the drain concentration of the P-type TFTs may be in the range of  $3E+19/cm^3$  to  $1E+20/cm^3$ . Therefore, it is possible to simplify the process of forming at least two types of TFTs having different driving voltages on an insulting glass substrate, thereby resulting in a greatly improved throughput.

[12] According to a third aspect of the present invention, a thin-film semiconductor device manufacturing method comprises forming substantially the same thickness of gate insulating films of a plurality of thin-film transistors (TFTs) having different driving voltages formed on a glass substrate at one time. Thus, according to the present invention, it is possible to form a plurality of thin-film transistors (TFTs) having different driving voltage on an glass substrate at a single gate insulating film. Therefore, it results in a greatly improved throughput.

### BRIEF DESCRIPTION OF THE DRAWINGS

[13] Fig. 1 is the cross-sectional view showing a conventional structure of a semiconductor.

[14] Fig. 2 is a cross-sectional view showing a structure of a thin-film semiconductor device related to a first embodiment of the present invention.

[15] Figs. 3 (a) and <sup>3</sup>(b) are cross-sectional views showing steps of a manufacturing method of the present invention.

4  
[16] Figs. 4 (a) through (c) are cross-sectional views showing steps of a manufacturing method of the present invention.

5  
[17] Figs. 5 (a) and (b) are cross-sectional views showing steps of a manufacturing method of the present invention.

6  
5 [18] Figs. 6 (a) through (c) are cross-sectional views showing steps of a manufacturing method of the present invention.

[19] Fig. 7 is a cross-sectional view showing a structure of a thin-film semiconductor device related to a second embodiment of the present invention.

### DETAILED DESCRIPTION OF THE INVENTION

10 [20] [First embodiment]

[21] Fig.2 shows a cross-sectional view showing a structure of a thin-film semiconductor device comprising a plurality of TFTs having different driving voltages related to a first illustrative embodiment of the present invention. Fig.3 through Fig.6 show cross-sectional view showing steps of a manufacturing method of the thin-film semiconductor device of the first embodiment in the present invention.

[22] As shown in Fig.2, an undercoat layer 102 is formed on a glass substrate 100, and amorphous or poly-crystalline silicon films 106-109 are formed on the undercoat layer. The gate insulating films 114-117 are provided on the amorphous or poly-crystal silicon films 106-109, and gate electrodes 110-113 are formed over the respective channel regions.

20 [23] The glass substrate 100 may be on a transparent insulating substrate made of glass or plastic, a silicon oxide film (SiO<sub>x</sub>). The undercoat layer 102 is provided to prevent an impurity from being diffused from the glass substrate 100 into an active layer and so it is not